# User Manual

Serval-640
and
Serval-384

ENG-2014-UMN008-R001

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Doc Ref: ENG-2014-UMN008
Issue: R001
Date: 15/04/2015
XF-104_02/20-01-2012

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# Revision History

| Issue | Issue date | Changes | Modified by | Approved by |
|---|---|---|---|---|
| 000.01 | 20/01/2015 | First draft | KNB | |
| 000.02 | 09/03/2015 | Add extra specifications | JDS/KNB | |
| 000.03 | 13/03/2015 | AT firmware revision<br>Feature list cleanup | BSN | |
| 000.04 | 27/03/2015 | Optical interface | JDH | |
| 000.05 | 31/03/2015 | Add accessories & list of abbreviations | KNB | |
| 000.06 | 10/04/2015 | add new version of IO kit | KNB | VVE |
| 000.07 | 13/04/2015 | corrected items in §1.6, §3.3, §5.6, §5.7, §5.12, §6.1, §6.2 and §7.3 | KNB | PDO |
| 000.08 | 14/04/2015 | Add manual IO panel as an appendix.<br>Reduce IO Panel info in manual | KNB | JDS |
| 000.09 | 15/04/2015 | Make software related changes | KNB | GGS, BSN |
| 001 | 15/04/2015 | Released issue | KNB | JDS |

# Change Details

This table lists all changes of this issue compared to the previous released one.

| Chapter/Section | Changes | Modified by |
|---|---|---|
| | | |
| | | |
| | | |

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# Table of Contents

Revision History ..... 3
Change Details ..... 3
List of Abbreviations ..... 7
List of Figures ..... 8
List of Tables ..... 9
1. Introduction ..... 11
1.1. Scope ..... 11
1.2. Manual Overview ..... 12
1.3. Reference Documents ..... 12
1.4. Conventions Used in This Manual ..... 13
1.5. Safety Warnings ..... 13
1.6. Conformity ..... 14
1.7. Contact Information ..... 15
2. Mechanical & Electrical Specifications ..... 16
2.1. Serval Detector Specifications ..... 16
2.2. Serval Camera Specifications ..... 16
3. Optical Interface ..... 18
4. Electrical Interface ..... 19
4.1. General Overview Connectors and Specifications ..... 19
4.2. GigE Interface ..... 20
4.3. I/O and Power Interface ..... 20
4.4. Description of LEDs ..... 21
4.5. Serval cables ..... 22
4.6. Serval Accessories ..... 22
4.7. External I/O panel ..... 23
5. Serval GigE Camera GenICam Features ..... 24
5.1. Device Control ..... 24
5.2. Image Format Control ..... 26

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5.3. Acquisition Control ..... 27
5.4. Digital I/O Control ..... 27
5.5. Event Control ..... 28
5.6. GenICam Control ..... 29
5.7. Transport Layer Control ..... 30
5.8. User Set Control ..... 31
5.9. File Access Control ..... 32
5.10. Radiometric Control ..... 33
5.11. Sensor Control ..... 33
5.12. Image processing control ..... 34
5.12.1. Auto gain and offset control ..... 34
5.12.2. Histogram equalization control ..... 35
5.12.3. Window control ..... 35
5.13. Image correction Control ..... 35
6. Software Installation ..... 36
6.1. Xeneth Installation ..... 36
6.2. SDK Installation ..... 36
7. Getting Started ..... 37
7.1. Install the Software ..... 37
7.2. Connect the Cables ..... 37
7.3. Connect the Camera via Xeneth ..... 37
7.4. Camera Properties ..... 38
7.4.1. Image Format Control ..... 38
7.4.2. Acquisition Control ..... 39
7.4.3. Sensor Control ..... 39
7.4.4. Image processing control ..... 39
7.4.4.1. Auto gain and offset control ..... 39
7.4.4.2. Histogram equalization control ..... 40
7.4.4.3. Window control ..... 40
7.4.5. Image Correction Control ..... 41
8. Firmware Revision History ..... 42

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8.1. LWIR module firmware revision history ..... 42
8.1.1. SOF-000076 revision history ..... 42
8.1.2. SOF-000125 Revision History ..... 42
8.2. GigE Vision core firmware revision history ..... 42
9. Appendices ..... 43
9.1. Appendix Mechanical Drawings ..... 43
9.2. Appendix Auto Gain Control ..... 43
9.3. Appendix Histogram Equalization ..... 43
9.4. Appendix Frame Rate Calculator ..... 43

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# List of Abbreviations

| | |
|---|---|
| a-Si | Amorphous Silicon |
| ASY | Assembly |
| CE | Conformité Européenne |
| CL | Camera Link protocol |
| GigE | Gigabit Ethernet |
| ICD | Interface Control Document |
| I/O | Input / output |
| LWIR | Long-Wave Infrared |
| NETD | Noise Equivalent Temperature Difference |
| RJ | Registered Jack |
| RoHS | Restriction of Hazardous Substances |
| SDK | Software Development Kit |
| SMA | Sub-Miniature version A connector |
| SW | Software |
| UMN | User manual |
| WOI | Window Of Interest |
| XEN | Xenics Part Number |
| XTM | Xenics Thermal Module |

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# List of Figures

Figure 3-1 Serval with lens cap removed ..... 18
Figure 4-1 GigE interface ..... 20
Figure 4-2 Male connector pin assignment ..... 20
Figure 4-3 Sunshroud - Mounting plate – Air purge & I/O kit ..... 22
Figure 7-1 Xeneth shortcut ..... 37
Figure 7-2 Connection dialog - settings ..... 37

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# List of Tables

Table 1-1 Camera and firmware version overview – Serval-640 ..... 11
Table 1-2 Camera and firmware version overview – Serval-384 ..... 11
Table 2-1 Serval detector specifications ..... 16
Table 2-2 Camera imaging specifications Serval-640 and Serval-384 ..... 16
Table 2-3 On board image processing features ..... 17
Table 2-4 Camera specifications Serval-640 and Serval-384 ..... 17
Table 2-5 Camera specifications: Physical characteristics ..... 18
Table 3-1 Lens configuration ..... 19
Table 4-1 Electrical interface specs for the Serval ..... 19
Table 4-2 GigE female connector pin assignment ..... 20
Table 4-3 I/O and power interface ..... 21
Table 4-4 Descriptions of LEDs ..... 21
Table 4-5 Serval cables ..... 22
Table 4-6 Serval accessories ..... 22
Table 4-7 Trigger functions ..... 23
Table 4-8 Line selection settings for triggering via the C2-I/O panel ..... 23
Table 5-1 Device control summary ..... 25
Table 5-2 Image format control summary ..... 26
Table 5-3 Acquisition control summary ..... 27
Table 5-4 Digital I/O control summary ..... 28
Table 5-5 Event control summary ..... 28
Table 5-6 Event acquisition summary ..... 29
Table 5-7 Event error summary ..... 29
Table 5-8 GenICam control summary ..... 29
Table 5-9 Transport layer control summary ..... 31
Table 5-10 User set control summary ..... 31
Table 5-11 File control summary ..... 32
Table 5-12 Sensor control ..... 33
Table 5-13 XTM Sensor specific features summary ..... 33
Table 5-14 Sensor uptime and lifetime ..... 33
Table 5-15 Image processing control ..... 34
Table 5-16 Auto gain and offset control ..... 34
Table 5-17 Histogram equalization control ..... 35
Table 5-18 Window control ..... 35
Table 5-19 Image correction Summary ..... 36
Table 8-1 SOF-000076 Firmware revision history ..... 42
Table 8-2 SOF-000076 Firmware change description ..... 42
Table 8-3 SOF-000125 Firmware revision history ..... 42
Table 8-4 SOF-000125 Firmware change description ..... 42

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Table 8-5 GigE Vision core firmware revision history ..... 42
Table 8-6 GigE Vision core firmware change description ..... 42

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# 1. Introduction

## 1.1. Scope

This User Manual describes the technical specifications, dimensions, image processing, basic and advanced parameters and related subjects for the Serval cameras.
An overview of the different configurations, together with current firmware version of the LWIR module, and the AT GigE Vision core are given in Table 1-1 and Table 1-2.

| Serval-640 Camera | Part Number | LWIR module firmware SOF-000076 | AT firmware |
|---|---|---|---|
| Serval-640-75mK-GigE-10mm Imaging | XEN-000542 | 2.1.1164 | 1.0.6 |
| Serval-640-75mK-GigE-10mm Thermography | XEN-000543 (*) | - | - |
| Serval-640-75mK-GigE-18mm Imaging | XEN-000544 | 2.1.1164 | 1.0.6 |
| Serval-640-75mK-GigE-18mm Thermography | XEN-000545 (*) | - | - |
| Serval-640-75mK-GigE-25mm Imaging | XEN-000546 | 2.1.1164 | 1.0.6 |
| Serval-640-75mK-GigE-25mm Thermography | XEN-000547 (*) | - | - |
| Serval-640-75mK-GigE-40mm Imaging | XEN-000548 | 2.1.1164 | 1.0.6 |
| Serval-640-75mK-GigE-40mm Thermography | XEN-000549 (*) | - | - |

*Table 1-1 Camera and firmware version overview – Serval-640*

| Serval-384 Camera | Part Number | LWIR module firmware SOF-000125 | AT firmware |
|---|---|---|---|
| Serval-384-80mK-GigE-10mm Imaging | XEN-000558 (*) | - | - |
| Serval-384-80mK-GigE-10mm Thermography | XEN-000559 (*) | - | - |
| Serval-384-80mK-GigE-18mm Imaging | XEN-000560 (*) | - | - |
| Serval-384-80mK-GigE-18mm Thermography | XEN-000561 (*) | - | - |
| Serval-384-80mK-GigE-25mm Imaging | XEN-000562 (*) | - | - |
| Serval-384-80mK-GigE-25mm Thermography | XEN-000563 (*) | - | - |
| Serval-384-80mK-GigE-40mm Imaging | XEN-000564 (*) | - | - |
| Serval-384-80mK-GigE-40mm Thermography | XEN-000565 (*) | - | - |

*Table 1-2 Camera and firmware version overview – Serval-384*

(*) planned

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## 1.2. Manual Overview

This section provides a chapter overview:

- Chapter 1 gives an overview of the conventions used in this manual (styles and symbols), the safety warnings, conformity information about Xenics cameras and the contact information.
- Chapter 2 gives a mechanical (2D drawings) and electrical overview.
- Chapter 3 describes the optical interfaces.
- Chapter 4 describes the electrical interfaces.
- Chapter 5 describes the Serval GigE camera GenICam features.
- Chapter 6 explains the software installation.
- Chapter 7 lists the steps to get started using the camera.
- Chapter 8 explains the firmware revision history.
- Chapter 9 lists the appendices.

## 1.3. Reference Documents

| | | |
|---|---|---|
| (Ref. 1) | Mechanical Drawing Serval | |
| (Ref. 2) | Auto Gain Control | ENG-2013-UMN006 |
| (Ref. 3) | Histogram Equalization | ENG-2014-UMN002 |
| (Ref. 4) | Frame rate calculator | ENG-2013-ICD012 |
| (Ref. 5) | Xeneth Installation Manual (see Xeneth SW directory) | ENG-2013-UMN024 |
| (Ref. 6) | Manual external I/O panel | |

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## 1.4. Conventions Used in This Manual

To give this manual an easily understood layout and to emphasize important information, the following typographical styles and symbols are used:

The styles used in this manual are:

- **Bold**: used for programs, inputs (commands or parameters) or highlighting important things
- `Courier New`: used for code listings and output.
- *Italics*: used for modes and fields.

The symbols used in this manual:

Note: This symbol highlights important information.

Warning: This symbol highlights important instructions. These instructions must be followed to avoid malfunctions!

## 1.5. Safety Warnings

The following safety warnings must be followed:

**Supply voltage polarity**: Use the correct polarity of the 12 V supply voltage.

**Warranty**: The warranty becomes void in case of unauthorized tampering or any manipulations not approved by the manufacturer.

**Electrostatic discharge**: The camera contains sensitive electronic components which can be destroyed by means of electrostatic discharge. Use sufficient grounding to minimize the risk of damage.

**Environmental conditions**: Operate the camera in dry and dust free environment.

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Regarding the signal quality of the camera it is an advantage to operate the camera under constant ambient air temperature (~20°C).

Beneath or above ambient temperature a sufficient heating or cooling may be necessary.

**Warm-up Period**: Depending on the prevailing environmental conditions, some time might pass after the camera start, until the image quality reaches its optimum.

## 1.6. Conformity

Xenics declares under its sole responsibility that all standard cameras of the Serval family to which this declaration relates to, are conform with the following standard(s) or other normative document(s):

- CE, following the provisions of 2004/108/EG directive
- RoHS (2002/95/EC).

CE:
We declare, under our sole responsibility, that the previously described Serval cameras conform to the CE directives.

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# 2. Mechanical & Electrical Specifications

The mechanical drawings of Serval can be found in Appendix Mechanical Drawings.

i The design and specifications for the products described below may change without notice.

## 2.1. Serval Detector Specifications

The detector specifications are summarized in Table 2-1.

| Parameter | Serval-640 | Serval-384 |
|---|---|---|
| Array Type | a-Si micro-bolometer | a-Si micro-bolometer |
| # pixels | 640 (W) x 480 (H) | 384 (W) x 288 (H) |
| Pixel pitch | 17 µm | 25 µm |
| Spectral Band | 8-14 µm | 8-14 µm |
| NETD | <75 mK @ 30°C with F/1 lens | <80 mK @ 30°C with F/1 lens |
| Detector Operating Mode | Rolling Shutter Mode | Rolling Shutter Mode |
| Window of interest | Yes | Yes |
| Exposure time range | 1 – 80 µs | 1 – 70 µs |
| Pixel Operability | >99% | >99% |

*Table 2-1 Serval detector specifications*

## 2.2. Serval Camera Specifications

The camera specifications are listed in Table 2-2, Table 2-3 and Table 2-4

| Imaging specifications | Serval-640 | Serval-384 |
|---|---|---|
| Frame rate (full frame) | 50 Hz (1) | 84 Hz |
| Window of interest | Yes | Yes |
| Smallest window of interest | 160 x 120 | 160x80 |
| WOI granularity | 4 x 1 | 4 x 1 |
| Max. frame rate in smallest window | 318 fps at $t_{exposure}$ = 25 µs<br>744 fps at $t_{exposure}$ < 10 µs | 442 fps at $t_{exposure}$ = 25 µs<br>650 fps at $t_{exposure}$ < 16 µs |
| Exposure time range | 1 – 80 µs | 1 – 70 µs |
| A/D conversion resolution | 16 bit | 16 bit |

*Table 2-2 Camera imaging specifications Serval-640 and Serval-384*

*(1) 50 Hz is achieved when using default packet delay (5000) + jumbo frames/ packets.*
*When using default packet delay (5000) + standard packet size: frame rate = ~35Hz*

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| On Board Image Processing Algorithms | Serval-640 Imaging | Serval-640 Thermography | Serval-384 Imaging | Serval-384 Thermography |
|---|---|---|---|---|
| NUC (non-uniformity correction) | x | x | x | x |
| Auto-Offset and Auto-Gain with selectable region of interest | x | | x | |
| Histogram Equalization | x | | x | |

*Table 2-3 On board image processing features*

| Camera Specifications | | Serval-640 | Serval-384 |
|---|---|---|---|
| **Interfaces** | | | |
| Camera control | GigE | x | x |
| Image Acquisition | GigE | x | x |
| Trigger | Trigger In / Out configurable | x | x |
| **Start-up** | | | |
| Self-starting | Yes | x | x |
| Start-up time | < 10s | x | x |
| Inrush current | 8 A at 12V | x | x |
| **Trigger Characteristics** | | | |
| Trigger In/Out | Different trigger in or out possibilities | x | x |
| **Power Requirements** | | | |
| Average power consumption (without shutter) | 5 W | x | x |
| Input Voltage | 12 V | x | x |
| **Environmental specifications** | | | |
| Shock | 40G, 11ms, according to MIL-STD810G | x | x |
| Vibration | 5G (20 to 2000 Hz), according to MIL-STD883J | x | x |
| Protection Rating | IP-67 | x | x |
| Min/max allowed operating case temperature | -40 to 70°C | x | x |
| Storage temperature | -45 to 85°C | x | x |

*Table 2-4 Camera specifications Serval-640 and Serval-384*

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| Camera Specifications | | Serval-10mm | Serval-18mm | Serval-25mm | Serval-40mm |
|---|---|---|---|---|---|
| **Physical characteristics** | | | | | |
| Dimensions ($mm^3$) | 55x55x122 | x | x | x | |
| | 55x55x134 | | | | x |
| Weight camera (g) | 475 | x | | | |
| | 460 | | x | | |
| | 495 | | | x | |
| | 540 | | | | x |

*Table 2-5 Camera specifications: Physical characteristics*

# 3. Optical Interface

The optical interface of the camera consists of three parts: the front, the lens cap (including Ge window) and the lens itself.

To acquire a sharp image of the target scene, the focus of the ring can manually be adjusted while monitoring the output of the camera.

Following procedure must be executed in a clean environment:

1) First remove the lens cap, while the camera is running. The lens cap can be removed by turning counterclockwise. The lens itself is now accessible.
2) Watch the video output from the camera and turn the focus ring on the lens until the image is sharp. The focus ring can be locked with a 0.9 hex key.
3) Turn the lens cap back on and tighten by hand.

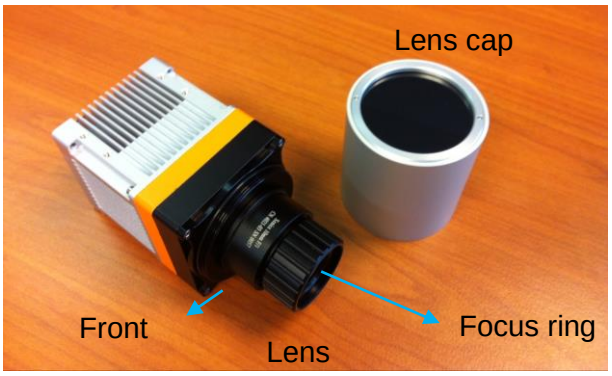


*Figure 3-1 Serval with lens cap removed*

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A list of all possible lenses for Serval is shown in Table 3-1.

| Lens configuration | Included on |
|---|---|
| LWIR lens 10mm f/1 | XEN-000542, XEN-000543, XEN-000558, XEN-000559 |
| LWIR lens 18mm f/1 | XEN-000544, XEN-000545, XEN-000560, XEN-000561 |
| LWIR lens 25mm f/1 | XEN-000546, XEN-000547, XEN-000562, XEN-000562 |
| LWIR lens 40mm f/1 | XEN-000548, XEN-000549, XEN-000563, XEN-000564 |

*Table 3-1 Lens configuration*

If there is dust on the lens it is recommended to remove it by blowing dry air. As a last resort it is possible to use a solvent to clean the lens:

Perform the following steps to clean a lens:

1. Immerse lens tissue in Iso-propanol or Ethanol (reagent grade).
2. Wipe the lens in "S" motion in such way that each lens area will not be wiped more than once!
3. Repeat stage 2 until the lens is clean. Use a new lens tissue each time!

# 4. Electrical Interface

## 4.1. General Overview Connectors and Specifications

Connect all cables to the connectors at the camera back (see also (Ref. 1)). Table 4-1 lists the connector and interface specifications overview of the Serval camera.

| Interface | Connector | Specification | Camera Protocol |
|---|---|---|---|
| GigE interface | Phoenix Contact 8P Female M12 connector (1553860) | See section 4.2 | GigE Vision |
| Power & I/O interface | Phoenix Contact 17P Male M12 connector (1437119) | See section 4.3 | |

*Table 4-1 Electrical interface specs for the Serval*

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## 4.2. GigE Interface

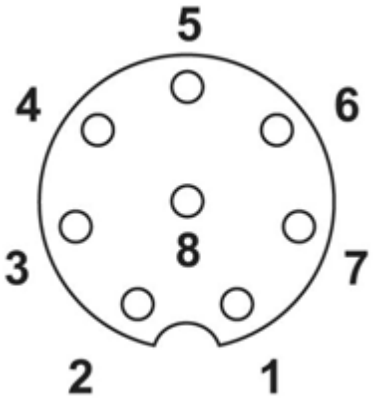


*Figure 4-1 GigE interface*

| Pin No. | GigE Signal Name |
|---|---|
| 1 | BI_DC- |
| 2 | BI_DD+ |
| 3 | BI_DD- |
| 4 | BI_DA- |
| 5 | BI_DB+ |
| 6 | BI_DA+ |
| 7 | BI_DC+ |
| 8 | BI_DB- |
| Shield | Shield |

*Table 4-2 GigE female connector pin assignment*

## 4.3. I/O and Power Interface

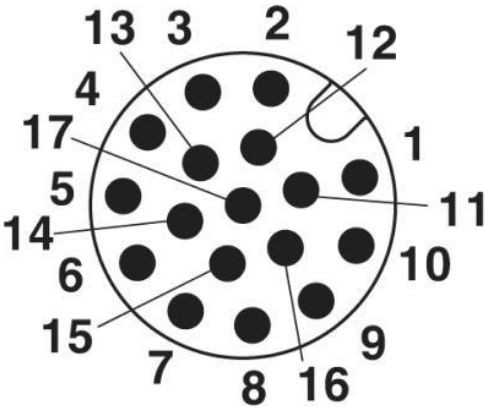


*Figure 4-2 Male connector pin assignment*

| Pin No. | Signal Name | Physical line | Description |
|---|---|---|---|
| 1 | Reserved | - | - |
| 2 | VCC_OUT0 | Line5 (DO0) | TTL-Output0 |
| 3 | ENC_Z | Line4 (DI4_Z) | Encoder |
| 4 | ENC_B | Line3 (DI3_B) | encoder Track1 |
| 5 | ENC_A | Line2 (DI2_A) | encoder Track2 |
| 6 | N.A. | - | - |
| 7 | N.A. | - | - |

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| | | | |
|---|---|---|---|
| 8 | VCC_EXT | VCC_EXT | camera supply voltage (10-24V DC) |
| 9 | GND_EXT | GND_EXT | main camera ground |
| 10 | N.A. | - | - |
| 11 | N.A. | - | - |
| 12 | VCC_OUT1 | Line6 (DO1) | TTL-Output1 |
| 13 | VCC_IN0 | Line0 (DI0) | TTL-Input0 |
| 14 | VCC_IN1 | Line1 (DI1) | TTL-Input1 |
| 15 | N.A. | - | - |
| 16 | N.A. | - | - |
| 17 | GND | GND | Reference ground for IO |
| Shield | SHIELD | SHIELD | is connected to camera case |

*Table 4-3 I/O and power interface*

## 4.4. Description of LEDs

| LED | Description |
|---|---|
| 1 (PWR) | Green On= Power On and camera start up completed<br>Off = Power Off or camera start up failed |
| 2 (USR) | <u>After Power On:</u><br>Off = no network cable connected<br>Green On = network connected<br><br><u>After Network connected:</u><br>Green On = CCP status connected<br>Off = CCP status disconnected<br><br>Red On= no network found, no network cable connected<br><br><u>During XTM file update:</u><br>Red On = File is transferred to XTM core (Do not disconnect power)<br>Green On = File transfer finished (Wait another 30s before repowering the camera, after uploading a correction file) |
| 3 (MOD) | Red On = Line7 (DO2_MOD_EN) is On<br>Off = Line7 (DO2_MOD_EN) is Off |
| 4 (ACT) | Green blink = Indication of network activity |
| 5 (LNK) | Green On = Linkspeed 1 Gbit<br>Amber On = Linkspeed 100 Mbit<br>Off = Linkspeed 10 Mbit or wait for end of autonegotiation |

*Table 4-4 Descriptions of LEDs*

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## 4.5. Serval cables

| Cables | | | Serval-640 | Serval-384 |
|---|---|---|---|---|
| M12 to RJ45 GigE cable 3m | ELC-002838 | Optional | x | x |
| M12 to RJ45 GigE cable 5m | ELC-002931 | Optional | x | x |
| M12 to RJ45 GigE cable 10m | ELC-002930 | Optional | x | x |
| Sensor-/actorkabel - SAC-17P-MS/ 3,0-PVC SCO | ELC-002947 | Optional | x | x |
| Sensor-/actorkabel - SAC-17P-MS/ 5,0-PVC SCO | ELC-002948 | Optional | x | x |
| I/O cable M12 on both ends 3m | ELC-002836 | Optional | x | x |
| Power supply 12V M12 Serval | ASY-000919 | Optional | x | x |
| Power cord | ELC-001288 | Optional (EUR) | x | x |
| | ELC-001500 | Optional (USA) | x | x |
| | ELC-001501 | Optional (UK) | x | x |

*Table 4-5 Serval cables*

## 4.6. Serval Accessories

| Accessories | | | Serval-640 | Serval-384 |
|---|---|---|---|---|
| Sunshroud | ASY-000915 | Optional | x | x |
| Mounting plate | ASY-000916 | Optional | x | x |
| Air purge | ASY-000917 | Optional | x | x |
| I/O kit | ASY-000918 | Optional | x | x |

*Table 4-6 Serval accessories*

*Figure 4-3 Sunshroud - Mounting plate – Air purge & I/O kit*

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## 4.7. External I/O panel

The I/O panel provides a user friendly way to connect the power and I/O of the Serval camera. It features following functions:

- Integrated RS422 receiver for use with differential encoder signals
- Opto-isolation of I/O signals
- Reverse polarity protection
-

An input trigger pulse should have a minimum width of 500ns.

Following functions could be assigned to the trigger lines:

| Trigger IN function |
|---|
| Acquisition start |
| Acquisition end |
| Frame start |

| Trigger OUT source |
|---|
| Off |
| Acquisition active |
| Frame active |
| Line active |
| User output 0 |
| User output 1 |
| User output 2 |

*Table 4-7 Trigger functions*

The line selection settings for triggering via the C2-I/O panel are shown in Table 4-8.

| Software Interface | C2-I/O-Panel | |
|---|---|---|
| **Trigger IN source** | **Clamp No.** | **Signal Name** |
| Line0 (DI0) | J400/7 | IN1 |
| Line1 (DI1) | J400/8 | IN2 |
| Line2 (DI2_A) | J300/7, J300/6 | A+, A- |
| Line3 (DI3_B) | J300/5, J300/4 | B+, B- |
| Line4 (DI4_Z) | J300/3, J300/2 | Z+, Z- |
| **Trigger OUT line selector** | **Clamp No.** | **Signal Name** |
| Line5 (DO0) | J400/5, J400/3 | OUT1, HV-OUT1 |
| Line6 (DO1) | J400/6, J400/4 | OUT2, HV-OUT2 |

*Table 4-8 Line selection settings for triggering via the C2-I/O panel*

Additional technical information about the I/O panel can be found in (Ref. 6)

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# 5. Serval GigE Camera GenICam Features

## 5.1. Device Control

Contains the features related to the control and information of the device.

| Name | Interface | Access | Unit | Visibility | Display name | Description |
|---|---|---|---|---|---|---|
| DeviceControl | ICategory | R | - | B | Device control | Category for device information and control. |
| DeviceScanType | IEnumeration | R | - | E | Scan type | Scan type of the sensor of the device. |
| DeviceVendorName | IString | R | - | B | Vendor name | Name of the manufacturer of the device. |
| DeviceModelName | IString | R | - | B | Model name | Model of the device. |
| DeviceManufacturerInfo | IString | R | - | B | Manufacturer info | Manufacturer information about the device. |
| DeviceVersion | IString | R | - | B | Version | Version of the device. |
| DeviceFirmwareVersion | IString | R | - | B | Firmware version | Version of the firmware in the device. |
| DeviceSerialNumber | IString | R | - | E | Serial number | Device`s serial number. |
| DeviceID | IString | R | - | I | ID | This feature is deprecated (See DeviceSerialNumber). |
| DeviceUserID | IString | R/W | - | B | User ID | User-programmable device identifier. |
| DeviceSFNCVersionMajor | IInteger | R | - | B | SFNC version major | Major version of the Standard Features Naming Convention that was used to create the device`s GenICam XML. |
| DeviceSFNCVersionMinor | IInteger | R | - | B | SFNC version minor | Minor version of the Standard Features Naming Convention that was used to create the device`s GenICam XML. |
| DeviceSFNCVersionSub Minor | IInteger | R | - | B | SFNC version subminor | Sub minor version of Standard Features Naming Convention that was used to create the device`s GenICam XML. |
| DeviceMaxThroughput | IInteger | R | Bps | E | Max throughput | Maximum bandwidth of the data that can be streamed out of the device. |
| DeviceStreamChannel Count | IInteger | R | - | E | Stream channel count | Indicates the number of streaming channels supported by the device. |
| DeviceEventChannel Count | IInteger | R | - | E | Event channel count | Indicates the number of event channels supported by the device. |
| DeviceReset | ICommand | W | - | G | Reset | Resets the device to its power up state. |
| DeviceRegistersStreaming Start | ICommand | (R)/W | - | G | Registers streaming start | Prepare the device for registers streaming without checking for consistency. |
| DeviceRegistersStreaming End | ICommand | (R)/W | - | G | Registers streaming end | Announce the end of registers streaming. |
| DeviceRegistersCheck | ICommand | (R)/W | - | E | Registers check | Perform the validation of the current register set for consistency. |
| DeviceRegistersValid | IBoolean | R | - | E | Registers valid | Returns if the current register set is valid and consistent. |

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| Name | Interface | Access | Unit | Visibility | Display name | Description |
|---|---|---|---|---|---|---|
| DeviceTemperature Selector | IEnumeration | R/W | - | E | Temperature selector | Selects the location within the device, where the temperature will be measured.<br><br>Sensor, Housing, Internal, Mainboard, Window |
| DeviceTemperature [DeviceTemperature Selector] | IFloat | R | C | E | Temperature | Device temperature in degrees Celsius. |
| CVBLic | IString | R | - | G | | License feature for camera locked CVB License ®. |
| DeviceCapability | IInteger | R | - | I | | hidden Bitmask of capabilities (hex):<br><br>0 : ModulationControl<br>1 : Radiometric<br>2 : InternalShutter<br>3: ExternalShutterTemp<br>4 : T-Linear<br>5: FocusMetric<br>6: HousingTemp<br>7: Improved AGC/DDE<br>8: Motorized Lens |

*Table 5-1 Device control summary*

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## 5.2. Image Format Control

Contains the features related to the format of the transmitted image.

| Name | Interface | Access | Unit | Visibility | Display name | Description |
|---|---|---|---|---|---|---|
| ImageFormatControl | ICategory | R | - | B | Image format control | Category for Image Format Control features. |
| SensorWidth | IInteger | R | - | E | Sensor width | Effective width of the sensor in pixels. |
| SensorHeight | IInteger | R | - | E | Sensor height | Effective height of the sensor in pixels. |
| WidthMax | IInteger | R | - | E | Width max | Maximum width of the image (in pixels).<br>Needed for Xeneth (can be invisible) |
| HeightMax | IInteger | R | - | E | Height max | Maximum height of the image (in pixels).<br>Needed for Xeneth (can be invisible) |
| Width | IInteger | R/W | - | B | Width | Width of the image provided by the device (in pixels). |
| Height | IInteger | R/W | - | B | Height | Height of the image provided by the device (in pixels). |
| OffsetX | IInteger | R/W | - | B | Offset X | Horizontal offset from the origin to the region of interest (in pixels). |
| OffsetY | IInteger | R/W | - | B | Offset Y | Vertical offset from the origin to the region of interest (in pixels). |
| LinePitch | IInteger | R/W | B | E | Line pitch | Total number of bytes between 2 successive lines (in bytes). |
| ReverseX | IBoolean | R/W | - | E | Reverse X | Flip horizontally the image sent by the device. |
| ReverseY | IBoolean | R/W | - | E | Reverse Y | Flip vertically the image sent by the device. |
| PixelFormat | IEnumeration | R | - | B | Pixel format | Format of the pixels provided by the device. |
| PixelSize | IEnumeration | R | - | E | Pixel size | Total size in bits of a pixel of the image. |
| PixelDynamicRangeMin | IInteger | R | - | E | Pixel dynamic range min | Minimum value that can be returned during the digitization process. |
| PixelDynamicRangeMax | IInteger | R | - | E | Pixel dynamic range max | Maximum value that will be returned during the digitization process. |
| TestPatternGenerator Selector | IEnumeration | R/W | - | B | Test pattern generator selector | Selects which test pattern generator is controlled by the TestPattern feature. |
| TestPattern[TestPattern GeneratorSelector] | IEnumeration | R/W | - | B | Test pattern | Selects the type of test pattern that is generated by the device as image source. |

*Table 5-2 Image format control summary*

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## 5.3. Acquisition Control

Contains the features related to image acquisition, including the triggering mode.

- Using AcquisitionFrameRate for reading actual frame rate

| Name | Interface | Access | Unit | Visibility | Display name | Description |
|---|---|---|---|---|---|---|
| AcquisitionControl | ICategory | R | - | B | Acquisition control | Category for the acquisition and trigger control features. |
| AcquisitionMode | IEnumeration | R/W | - | B | Mode | Sets the acquisition mode of the device. |
| AcquisitionStart | ICommand | R/W | - | B | Start | Starts the acquisition of the device. |
| AcquisitionStop | ICommand | R/W | - | B | Stop | Stops the acquisition of the device at the end of the current frame. |
| AcquisitionAbort | ICommand | R/W | - | E | Abort | Aborts the acquisition immediately. |
| AcquisitionFrameCount | IInteger | R/W | - | B | Frame count | Number of frames to acquire in MultiFrame acquisition mode. |
| AcquisitionFrameRate | IFloat | R/W | Hz | B | Frame rate | Controls the acquisition rate (in Hertz) at which the frames are captured. |
| AcquisitionStatusSelector | IEnumeration | R/W | - | E | Status selector | Selects the internal acquisition signal to read using AcquisitionStatus. |
| AcquisitionStatus [AcquisitionStatusSelector] | IBoolean | R | - | E | Status | Reads the state of the internal acquisition signal selected using AcquisitionStatusSelector. |
| TriggerControl | ICategory | R | - | B | Trigger control | Subcategory for the trigger functions |
| TriggerSelector | IEnumeration | R/W | - | B | Selector | Selects the type of trigger to configure. |
| TriggerMode[Trigger Selector] | IEnumeration | R/W | - | B | Mode | Controls if the selected trigger is active. |
| TriggerSoftware[Trigger Selector] | ICommand | W | - | B | Software | Generates an internal trigger for selected trigger. |
| TriggerSource[TriggerSelector] | IEnumeration | R/W | - | B | Source | Specifies the internal signal or physical input Line to use as the trigger source. |
| ExposureTime | IFloat | R/W | us | B | Exposure Time | Sets the Exposure time (in us).<br>XTM-640: 1-80us<br>XTM-384: 1-70us |

*Table 5-3 Acquisition control summary*

## 5.4. Digital I/O Control

Contains the features related to the control of the general input and output pins of the device.

| Name | Interface | Access | Unit | Visibility | Description |
|---|---|---|---|---|---|
| DigitalIOControl | ICategory | R | - | E | Category that contains the digital input and output control features. |
| LineControl | ICategory | R | - | E | Subcategory for the line settings. |
| LineSelector | IEnumeration | R/W | - | E | Selects the physical line (or pin) of the external device connector to configure. |
| LineMode[LineSelector] | IEnumeration | R | - | E | Controls if the physical line is used to input or output a signal. |
| LineInverter[LineSelector] | IBoolean | R/W | - | E | Controls the inversion of the signal of the selected input or output line. |
| LineStatus[LineSelector] | IBoolean | R | - | E | Returns the current status of the selected input or output line. |
| LineStatusAll | IInteger | R | - | E | Returns the current status of all available line signals at time of polling in a single bitfield. |
| LineSource[LineSelector] | IEnumeration | R/W | - | E | Selects which internal acquisition or I/O source signal to output on the selected line.<br>Sources: *Off, AcquisitionActive, FrameActive, LineActive,* |

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| | | | | | |
|---|---|---|---|---|---|
| | | | | | *(ModulationActive, ModulationClock, ) UserOutput0, UserOutput1, UserOutput2* |
| UserOutputControl | ICategory | R | - | E | Subcategory for the user outputs. |
| UserOutputSelector | IEnumeration | R/W | - | E | Selects which bit of the user output register will be set by UserOutputValue. |
| UserOutputValue [UserOutputSelector] | IBoolean | R/W | - | E | Sets the value of the bit selected by UserOutputSelector. |

*Table 5-4 Digital I/O control summary*

## 5.5. Event Control

Contains the features related to the generation of Event notifications by the device.

| Name | Interface | Access | Unit | Visibility | Description |
|---|---|---|---|---|---|
| EventControl | ICategory | R | - | E | Category that contains event control features. |
| EventSelector | IEnumeration | R/W | - | E | Selects which event to signal to the host application.<br><br>AcquisitionStart = 0x9012<br>AcquisitionEnd = 0x9013<br>ImageCaptureStarted = 0x9018<br>ImageCaptureStopped = 0x9019<br>Line0RisingEdge (HS_IN_0) = 0x9020<br>Line1RisingEdge (HS_IN_1) = 0x9021 |
| EventNotification[EventSelector] | IEnumeration | R/W | - | E | Activate or deactivate the notification to the host application of the occurrence of the selected event. |

*Table 5-5 Event control summary*

For each event in Event selector we have a ICatgeory Event prefix + "EventName" + Data postfix (e.g. EventAcquisitionStartData)

You must provide an IInteger Event feature that will be used to register the callback and is named: Event prefix +"EventName" (e.g.EventAcquisitionStart).
You should provide for each optional data member a corresponding feature named: Event prefix + "EventName"+"DataMember" (e.g. EventAcquisitionStartTimestamp)
The recommended optional data members are:

- Timestamp: Unique timestamp of the Event.
- FrameID: Unique ID of the Frame (or image) that generated the Event.
- Followed by any other data related to this particular event

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| Name | Interface | Access | Unit | Visibility | Description |
|---|---|---|---|---|---|
| EventAcquisitionStartData | ICategory | R | - | E | Category that contains all the data features related to the AcquisitionStart. |
| EventAcquisitionStart | IInteger | R | - | E | Returns the unique Identifier of the Acquisition Start type of Event. |
| EventAcquisitionStartTimestamp | IInteger | R | - | E | Returns the Timestamp of the Acquisition Start Event. |
| EventAcquisitionStartFrameID | IInteger | R | - | E | Returns the unique Identifier of the Frame (or image) that generated the Acquisition Start Event. |

*Table 5-6 Event acquisition summary*

| Name | Interface | Access | Unit | Visibility | Description |
|---|---|---|---|---|---|
| EventErrorData | ICategory | R | - | E | Category that contains all the data features related to the Error Event. |
| EventError | IInteger | R | - | E | Returns the unique identifier of the Error type of Event. |
| EventErrorTimestamp | IInteger | R | - | E | Returns the Timestamp of the Error Event. |
| EventErrorFrameID | IInteger | R | - | E | If applicable, returns the unique Identifier of the Frame (or image) that generated the Error Event. |
| EventErrorCode | IInteger | R | - | E | Returns an error code for the error(s) that happened. |

*Table 5-7 Event error summary*

## 5.6. GenICam Control

Contains the features related to GenICam control and access.

| Name | Interface | Access | Unit | Visibility | Description |
|---|---|---|---|---|---|
| Root | ICategory | R | - | G | Provides the Root of the GenICam features tree. |
| Device | IPort | R/W | - | I | Provides the default GenICam port of the Device. |
| TLParamsLocked | IInteger | R/W | - | I | Used by the Transport Layer to prevent critical features from changing during acquisition. |

*Table 5-8 GenICam control summary*

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## 5.7. Transport Layer Control

Contains the features related to the Transport Layer Control.

| Name | Interface | Access | Unit | Visibility | Description |
|---|---|---|---|---|---|
| TransportLayerControl | ICategory | R | - | B | Category that contains the transport Layer control features. |
| PayloadSize | IInteger | R | B | E | Provides the number of bytes transferred for each image or chunk on the stream channel. |
| DeviceTapGeometry | IEnumeration | R/(W) | - | E | This device tap geometry feature describes the geometrical properties characterizing the taps of a camera as presented at the output of the device. |
| GigEVision | ICategory | R | - | B | Category that contains the features pertaining to the GigE Vision transport layer of the device. |
| GevVersionMajor | IInteger | R | - | E | This feature is deprecated (See DeviceTLVersionMajor). |
| GevVersionMinor | IInteger | R | - | E | This feature is deprecated (See DeviceTLVersionMinor). |
| GevDeviceModeIsBigEndian | IBoolean | R | - | G | This feature is deprecated (See DeviceRegistersEndianess). |
| GevLinkSpeed | IInteger | R | Mbs | E | This feature is deprecated (See DeviceLinkSpeed). |
| GevMACAddress | IInteger | R | - | B | MAC address of the logical link. |
| GevCurrentIPConfigurationLLA | IBoolean | R/W | - | B | Controls whether the Link Local Address IP configuration scheme is activated on the given logical link. |
| GevCurrentIPConfigurationDHCP | IBoolean | R/W | - | B | Controls whether the DHCP IP configuration scheme is activated on the given logical link. |
| GevCurrentIPConfigurationPersistentIP | IBoolean | R/W | - | B | Controls whether the PersistentIP configuration scheme is activated on the given logical link. |
| GevCurrentIPAddress | IInteger | R | - | B | Reports the IP address for the given logical link. |
| GevCurrentSubnetMask | IInteger | R | - | B | Reports the subnet mask of the given logical link. |
| GevCurrentDefaultGateway | IInteger | R | - | B | Reports the default gateway IP address to be used on the given logical link. |
| GevIPConfigurationStatus | IEnumeration | R | - | B | Reports the current IP configuration status. |
| GevFirstURL | IString | R | - | G | Indicates the first URL to the GenICam XML device description file. |
| GevSecondURL | IString | R | - | G | Indicates the second URL to the GenICam XML device description file. |
| GevPersistentIPAddress | IInteger | R/W | - | B | Controls the Persistent IP address for this logical link. |
| GevPersistentSubnetMask | IInteger | R/W | - | B | Controls the Persistent subnet mask associated with the Persistent IP address on this logical link. |
| GevPersistentDefaultGateway | IInteger | R/W | - | B | Controls the persistent default gateway for this logical link. |
| GevMessageChannelCount | IInteger | R | - | E | This feature is deprecated (See DeviceEventChannelCount). |
| GevStreamChannelCount | IInteger | R | - | E | This feature is deprecated (See DeviceStreamChannelCount). |
| GevHeartbeatTimeout | IInteger | R/W | ms | G | This feature is deprecated (See DeviceLinkHeartbeatTimeout). |
| GevTimestampTickFrequency | IInteger | R | Hz | E | This feature is deprecated (See the increment of the TimestampLatchValue feature). |
| GevTimestampControlLatch | ICommand | W | - | E | This feature is deprecated (See TimestampLatch). |
| GevTimestampControlReset | ICommand | W | - | E | This feature is deprecated (See TimestampReset). |
| GevTimestampValue | IInteger | R | | E | This feature is deprecated (See TimestampLatchValue). |

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| Name | Interface | Access | Unit | Visibility | Description |
|---|---|---|---|---|---|
| GevStreamChannelSelector | IInteger | R/W | - | E | Selects the stream channel to control. |
| GevSCPInterfaceIndex[GevStreamChannelSelector] | IInteger | R/(W) | - | G | Index of the logical link to use. |
| GevSCPSPacketSize[GevStreamChannelSelector] | IInteger | R/(W) | B | E | This feature is deprecated (See DeviceStreamChannelPacketSize). |
| GevSCPD[GevStreamChannelSelector] | IInteger | R/W | | E | Controls the delay (in GEV timestamp counter unit) to insert between each packet for this stream channel. |

*Table 5-9 Transport layer control summary*

## 5.8. User Set Control

Contains the features related to the User Set Control to save and load the user device settings.

| Name | Interface | Access | Unit | Visibility | Display name | Description |
|---|---|---|---|---|---|---|
| UserSetControl | ICategory | R | - | B | User set control | Category that contains the User Set control features. |
| UserSetSelector | IEnumeration | R/W | - | B | Selector | Selects the feature User Set to load, save or configure.<br><br>Factory<br>UserSet0 |
| UserSetLoad[UserSetSelector] | ICommand | W | - | B | Load | Loads the User Set specified by UserSetSelector to the device and makes it active. |
| UserSetSave[UserSetSelector] | ICommand | W | - | B | Save | Save the User Set specified by UserSetSelector to the non-volatile memory of the device. |
| UserSetDefault | IEnumeration | R/W | - | B | Default | Selects the feature User Set to load and make active by default when the device is reset.<br><br>Default (factory settings)<br>UserSet0 |

*Table 5-10 User set control summary*

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## 5.9. File Access Control

Contains the features related to the File that provides all the services necessary for generic file access of a device.

- The files can be selected via the “FileSelector”.
- The XTM Core_firmware/Correction files can only be used through the ‘Storage’ tab in Xeneth.

| Name | Interface | Access | Unit | Visibility | Display name | Description |
|---|---|---|---|---|---|---|
| FileAccessControl | ICategory | R | - | G | File access control | Category that contains the File Access control features. |
| FileSelector | IEnumeration | R/(W) | - | G | Selector | Selects the target file in the device.<br><br>UserSetDefault<br>UserSet0<br>UserData<br>Core_firmware<br>Correction |
| FileOperationSelector[FileSelector] | IEnumeration | R/W | - | G | Operation selector | Selects the target operation for the selected file in the device. |
| FileOperationExecute[FileSelector][FileOperationSelector] | ICommand | R/W | - | G | Operation execute | Executes the operation selected by FileOperationSelector on the selected file. |
| FileOpenMode[FileSelector] | IEnumeration | R/(W) | - | G | Open mode | Selects the access mode in which a file is opened in the device. |
| FileAccessBuffer | IRegister | R/(W) | - | G | Access buffer | Defines the intermediate access buffer that allows the exchange of data between the device file storage and the application. |
| FileAccessBufferStart (visibility hidden for compatibility with Xeneth SW) | IInteger | R | - | I | Acces buffer start | same as FileAccessBuffer:Address for Xeneth File necessary |
| FileAccessBufferLength (visibility hidden for compatibility with Xeneth SW) | IInteger | R | - | I | Access buffer length | same as FileAccessBuffer:Length for Xeneth File necessry |
| FileAccessOffset[FileSelector][FileOperationSelector] | IInteger | R/(W) | B | G | Access offset | Controls the Offset of the mapping between the device file storage and the FileAccessBuffer. |
| FileAccessLength[FileSelector][FileOperationSelector] | IInteger | R/W | B | G | Access length | Controls the Length of the mapping between the device file storage and the FileAccessBuffer. |
| FileOperationStatus[FileSelector][FileOperationSelector] | IEnumeration | R | - | G | Operation status | Represents the file operation execution status. |
| FileOperationResult[FileSelector][FileOperationSelector] | IInteger | R | - | G | Operation result | Represents the file operation result. |
| FileSize[FileSelector] | IInteger | R | B | G | Size | Represents the size of the selected file in bytes. |

*Table 5-11 File control summary*

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## 5.10.Radiometric Control

PLANNED

## 5.11.Sensor Control

| Name | Interface | Access | Unit | Visibility | Display name | Description |
|---|---|---|---|---|---|---|
| SensorControl | ICategory | R | - | B | Sensor control | Category that contains the sensor control features. |
| SensorSerialNumber | IString | R | - | G | Serial number | Sensor's serial number |
| SensorFirmwareVersion | IString | R | - | G | Firmware version | Version of the sensor firmware |
| SensorPN | IString | R | - | G | Part number | Sensor part number |
| SensorType | IEnumeration | R | - | G | Type | XTM-640, XTM-384 |
| SensorSetDefaults | ICommand | W | - | G | Set defaults | Set all current settings as power-on defaults |
| SensorReset | ICommand | W | - | G | Reset | Reset Sensor core |

*Table 5-12 Sensor control*

| Name | Interface | Access | Unit | Visibility | Display name | Description |
|---|---|---|---|---|---|---|
| SensorControl | ICategory | R | - | B | Sensor control | Category that contains the sensor control features. |
| DeviceGain | IEnumeration | R/W | - | G | Gain | Sets the gain mode.<br>XTM-640: 3, 1.5, 1<br>XTM-384: 4, 2, 1.33, 1 |
| DeviceGFIDVoltage | IFloat | R/W | V | G | GFID voltage | Detector GFID bias voltage |
| DeviceGSKVoltage (for 640)<br><br>DeviceVSKVoltage (for 384) | IFloat | R/W | V | G | GSK voltage<br>VSK voltage<br>(depending on version) | Detector GSK/VSK bias voltage |
| MinimumFrameTime | IInteger | R | us | E | Minimum frame time | The interval time for the internal trigger. |
| | | | | | | |

*Table 5-13 XTM Sensor specific features summary*

| Name | Interface | Access | Unit | Visibility | Display Name | Description |
|---|---|---|---|---|---|---|
| SensorUpTime | IInteger | R | sec | G | Up time | Elapsed time since last startup |
| SensorLifeTime | IInteger | R | min | G | Life time | Total elapsed 'power on' time, saved in 15min increments |

*Table 5-14 Sensor uptime and lifetime*

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## 5.12.Image processing control

For the current configuration as industrial radiometric camera (Serval Thermography camera) we disable the additional image processing features of the Xenics-XTM.

| Name | Interface | Access | Unit | Visibility | Display name | Description |
|---|---|---|---|---|---|---|
| ImageProcessingControl | ICategory | R | - | B | Image processing control | Category that contains the XTM image processing features |

*Table 5-15 Image processing control*

### 5.12.1. Auto gain and offset control

| Name | Interface | Access | Unit | Visibility | Display name | Description |
|---|---|---|---|---|---|---|
| AutoGainControl | ICategory | R | - | B | Auto gain control | Subcategory that contains the AGC features (subcat of Image processing control) |
| GainControl | IEnumeration | R/W | - | B | Gain control | Automatic, Manual |
| OffsetControl | IEnumeration | R/W | - | B | Offset control | Automatic, Manual |
| AutoModeUpdate | IEnumeration | R/W | - | E | Auto mode update | Running, Stopped |
| OffsetUsed | IFloat | RO | | B | Offset used | Currently applied offset |
| GainUsed | IFloat | RO | | B | Gain used | Currently applied gain |
| ManualModeControl | ICategory | R | - | B | Manual mode control | Subsubcategory (subcat of Auto gain control) |
| ManualModeOffset | IFloat | R/W | | B | Offset | Manual offset level |
| ManualModeGain | IFloat | R/W | | B | Gain | Manual gain factor |
| AutoModeControl | ICategory | R | - | E | Auto mode control | Subsubcategory (subcat of Auto gain control) |
| AutoModeOutputHistogramMidpoint | IFloat | R/W | | E | Output histogram midpoint | Target point for automatic offset leveling |
| AutoModeMaximalGain | IFloat | R/W | | E | Maximal gain | Maximum allowed automatic gain |
| AutoModeRegulationSpeed | IInteger | R/W | | E | Regulation speed | Speed of automatic offset/gain changes |
| OutliersControl | ICategory | R | - | E | Outliers control | Subsubcategory (subcat of Auto gain control) |
| OutliersExpressedAs | IEnumeration | R/W | - | E | Expressed as | % of the image size, % of the maximal intensity |
| OutliersDark | IFloat | R/W | | E | Dark | Dark outliers to ignore |
| OutliersBright | IFloat | R/W | | E | Bright | Bright outliers to ignore |
| OutliersBrightDisplayColor | IEnumeration | R/W | - | E | Bright display color | White, Black |
| InputHistogramControl | ICategory | R | - | E | Input histogram control | Subsubcategory (subcat of Auto gain control) |
| InputHistogramBegin | IFloat | R/W | | E | Begin | Desired starting point in the input histogram |
| InputHistogramMidpoint | IFloat | R/W | | E | Midpoint | Desired midpoint in the input histogram |
| InputHistogramEnd | IFloat | R/W | | E | End | Desired end point in the input histogram |

*Table 5-16 Auto gain and offset control*

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### 5.12.2. Histogram equalization control

| Name | Interface | Access | Unit | Visibility | Display name | Description |
|---|---|---|---|---|---|---|
| HistogramEqualizationControl | ICategory | R | - | B | Histogram equalization control | Subcategory that contains the HE features (subcat of Image processing control) |
| HistogramEqualizationEnable | IEnumeration | R/W | - | B | Enable | Off, On |
| HistogramEqualizationFreeze | IEnumeration | R/W | - | E | Freeze | Freeze the current internal transformation data<br><br>Off, On |
| HistogramEqualizationStrength | IInteger | R/W | - | E | Strength | XTM-640: 0-17<br>XTM-384: 2-17 |
| HistogramEqualizationDarkOutliers | IFloat | R/W | | G | Dark outliers | Dark outliers to ignore |
| HistogramEqualizationBrightOutliers | IFloat | R/W | | G | Bright outliers | Bright outliers to ignore |

*Table 5-17 Histogram equalization control*

### 5.12.3. Window control

| Name | Interface | Access | Unit | Visibility | Display name | Description |
|---|---|---|---|---|---|---|
| WindowControl | ICategory | R | - | E | Window control | Subcategory that contains the Processing Window features (subcat of Image processing control) |
| WindowEnable | IEnumeration | R/W | - | E | Enable | Off, On |
| WindowWidth | IInteger | R/W | - | E | Width | |
| WindowHeight | IInteger | R/W | - | E | Height | |
| WindowOffsetX | IInteger | R/W | - | E | Offset X | |
| WindowOffsetY | IInteger | R/W | - | E | Offset Y | |

*Table 5-18 Window control*

## 5.13.Image correction Control

| Name | Interface | Access | Unit | Visibility | Display name | Description |
|---|---|---|---|---|---|---|
| ImageCorrectionControl | ICategory | R | - | B | | Category for the image correction control features. |
| RawMode | IEnumeration | R/W | - | G | Raw mode | Enable raw mode. Bypasses all image correction and image processing steps. (important feature for production scripts) |
| FPNCorrection | IEnumeration | R/W | - | G | FPN correction | Off, On |
| PRNUCorrection | IEnumeration | R/W | - | G | PRNU correction | Off, On |
| BPRCorrection | IEnumeration | R/W | - | G | BPR correction | Off, On |
| Calibrate | IComand | W | - | B | Calibrate | Performs shutter operation and update of FPN correction |

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| Name | Interface | Access | Unit | Visibility | Display name | Description |
|---|---|---|---|---|---|---|
| AutoCorrectionControl | ICategory | R | - | E | Auto correction control | Subcategory of image correction control |
| AutoCorrectionEnabled | IEnumeration | R/W | - | E | Auto correction | Disabled<br>Enabled<br>External (use external shutter for correction) |
| AutoCorrectionDeltaTemperature | IFloat | R/W | C | E | Delta temperature | Maximum detector temperature difference between automatic shutter actions |
| AutoCorrectionDeltaTime | IInteger | R/W | s | E | Delta time | Maximum time between automatic shutter actions |
| ShutterControl | ICategory | R | - | G | Shutter control | Subcategory of image correction control |
| ShutterClose | IComand | W | - | G | Close | |
| ShutterOpen | IComand | W | - | G | Open | |
| ShutterTime | IInteger | R | ns | I | Shutter time | Completion time of last shutter action |

*Table 5-19 Image correction Summary*

# 6. Software Installation

Before being able to start the camera, the Xeneth imaging suite (at least version 2.4) and its graphical user interface must be installed, so that the data coming from a wide variety of Xenics detectors and cameras can be easily operated on and analyzed.

## 6.1. Xeneth Installation

It is a good practice to first uninstall a previous Xeneth version when installing a new one.

Refer to the Xeneth Installation Manual (Ref. 5) that is delivered on the USB device together with the camera to install Xeneth.

## 6.2. SDK Installation

The optional SDK installation file is delivered on the USB device together with the camera. Install the SDK software using this file.

After the SDK installation, the SDK manual, together with the samples and header files can be found in the C:\Program Files\Xeneth\SDK directory.

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# 7. Getting Started

## 7.1. Install the Software

First perform the Xeneth installation and when necessary the SDK installation as well (see section 0).

## 7.2. Connect the Cables

The cable information and interfaces is described in section 4.

## 7.3. Connect the Camera via Xeneth

Click the Xeneth shortcut on the desktop to start up Xeneth (see Figure 7-1). The connection dialog will become visible (see Figure 7-2). When the camera is not shown, click the refresh button on the dialog. Select the camera, and click OK. For more details, consult the Xeneth User Manual, section Connection setup - Settings.

*Figure 7-1 Xeneth shortcut*

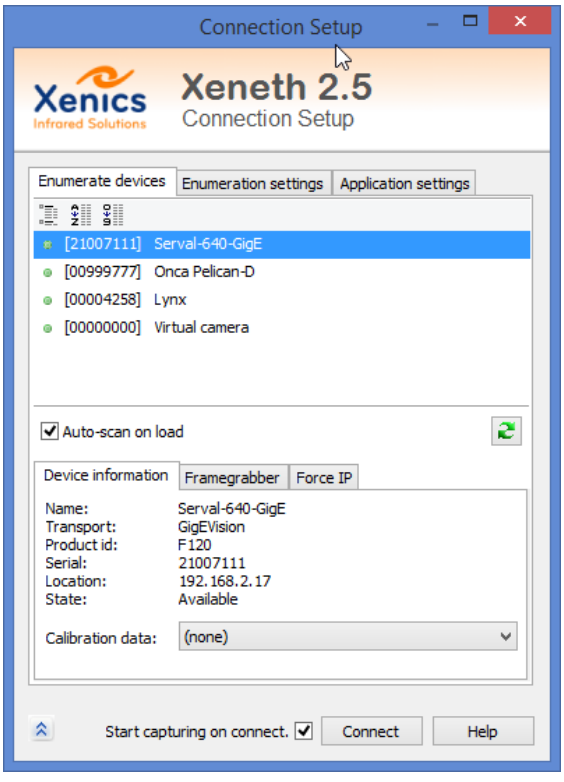


*Figure 7-2 Connection dialog - settings*

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## 7.4. Camera Properties

Here we will describe the most important features and properties of the Serval camera.

### 7.4.1. Image Format Control

See also section 5.2 for more detailed information.

It is possible to window and/or flip the image from the detector. By windowing a higher framerate can be achieved (see also (Ref. 4)).

When changing the registers, it will come into effect immediately after the current frame has finished. The calibration will always be updated whenever one of the windowing parameters is changed.

The minimal window dimensions are:

- 160 x 120 (for Serval-640)
- 160 x 80 (for Serval-384)

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### 7.4.2. Acquisition Control

See also section 0 for more detailed information.

The bolometer detector exposure time can be changed between 1 and 80 microseconds (for the Serval-640) and between 1 and 70 microseconds (for the Serval-384). The default exposure time is 25µs.

### 7.4.3. Sensor Control

See also section 5.11 for more detailed information.

The detector bias voltages (GSK/VSK and GFID) and detector gain are unique for each module and are pre-programmed into the non-volatile memory. They are optimized for maximum performance. Changing them requires a good understanding of the detector physics, also the calibration stored into the module becomes invalid. For normal operation, there is no need to change them.

### 7.4.4. Image processing control

#### 7.4.4.1. Auto gain and offset control

See also (Ref. 2) and section 7.4.4.1 for more detailed information.

- The gain applied to the image can be controlled manually or calculated automatically. The gain only stretches the histogram span and does not influence the offset of the input image
  - Manual gain mode: The gain is fixed and equal to the value set in the *Manual Gain* field.
  - Automatic gain mode: The gain in is adapted automatically to use the full dynamic range at the output. This mode in combination with the automatic offset mode maximizes the contrast of the output image. The *Maximal Gain* field limits the maximal gain that will be applied.

- The offset added to the input image can be set manually or calculated automatically. The offset added to the input histogram is only shifting the histogram along the intensity axis. It does not influence the histogram span.
  - Manual offset mode: The offset is fixed and equal to the value set in the *Manual Offset* field.
  - Automatic offset mode: The offset is adapted automatically to keep the midpoint of the output histogram at the programmed O*utput Histogram Midpoint* value. This mode in combination with the automatic gain mode maximizes the contrast of the output image.

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#### 7.4.4.2. Histogram equalization control

See also (Ref. 3) and section 5.12.2 for more detailed information.

After applying the gain and offset algorithm, it is possible apply a histogram equalization, in order to enhance the contrast in the image. The main parameter to get ‘more’ or ‘less’ equalization is the Histogram Equalization Strength.

#### 7.4.4.3. Window control

See also section 5.12.3 for more detailed information.

As mentioned above, the offset and gain control is based on the histogram information of the complete image. With the region of interest for automatic offset and gain, a part of the image can be selected of which the histogram information will be used by the automatic offset and gain. This allows to ignore a part of the image in the automatic offset and gain calculations. To obtain predictable results, it is important that the region of interest for automatic offset and gain contains sufficient contrast.

If the region of interest for the automatic offset and gain is bigger than the region of interest of the sensor, only the part both regions of interest have in common will be passed.

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### 7.4.5. Image Correction Control

See also section 5.13 for more detailed information.

On the Serval camera, onboard correction is performed in order to correct for the non-uniformities of the detector. The following corrections are typically performed:

- FPN: fixed pattern noise correction, using the mechanical shutter
- PRNU: photo-response non-uniformity correction
- BPR: bad pixel replacement

If the auto correction operation is enabled, shutter operations will be performed automatically, whenever the maximum 'Delta time' or maximum 'Delta temperature' are exceeded. When the module is busy with auto calibration, no new frames are transmitted.

Other events that trigger an automatic calibration operation are:

- Change in exposure time
- Change of WOI.

Commands that affect the shutter operation:

- Close shutter
- Open shutter
- Calibrate.

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# 8. Firmware Revision History

## 8.1. LWIR module firmware revision history

### 8.1.1. SOF-000076 revision history

| SOF-000076 Revision History (Serval-640) | | |
|---|---|---|
| Version | Date | Changes |
| 2.1.1164 | 20/05/2014 | - |

*Table 8-1 SOF-000076 Firmware revision history*

| SOF-000076 Change Description ((Serval-640)) | |
|---|---|
| | No changes yet |

*Table 8-2 SOF-000076 Firmware change description*

### 8.1.2. SOF-000125 Revision History

| SOF-0000125 Revision History (Gobi/XTM-640-CL; XTM-384-16bitDV) | | |
|---|---|---|
| Version | Date | Changes |
| 2.1.198 | 09/10/2014 | - |

*Table 8-3 SOF-000125 Firmware revision history*

| SOF-000125 Change Description (Gobi/XTM-384-CL; XTM-384-16bitDV) | |
|---|---|
| | No changes yet |

*Table 8-4 SOF-000125 Firmware change description*

## 8.2. GigE Vision core firmware revision history

| GigEVision core firmware Revision History (Serval-640/384) | | |
|---|---|---|
| Version | Date | Changes |
| 1.0.6 | 03/03/2015 | - |

*Table 8-5 GigE Vision core firmware revision history*

| GigEVision core firmware Change Description (Serval-640/384) | |
|---|---|
| | No changes yet |

*Table 8-6 GigE Vision core firmware change description*

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# 9. Appendices

## 9.1. Appendix Mechanical Drawings

The complete mechanical drawings of the Serval can be found in (Ref. 1).

## 9.2. Appendix Auto Gain Control

More detailed information on the Auto Gain Control functionality is provided in (Ref. 2).

## 9.3. Appendix Histogram Equalization

More detailed information on the Histogram Equalization functionality is provided in (Ref. 3)

## 9.4. Appendix Frame Rate Calculator

The achievable frame rate and the minimal required frame time can be calculated using the Frame rate calculator in (Ref. 4)

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